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Ionospheric Anomalies prior to Recent Large Magnitude Earthquakes in Greece observed by GPS Data

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The relationship between large magnitude earthquakes (Mw>6) and ionospheric anomalies in the most seismically active area of Greece is investigated. The applied methodology is based on the propagation effect of the GPS satellite transmitted signal through Ionosphere as defined in Electromagnetic (EM) Wave Propagation and Plasma Theory. Total Electron Content (TEC) in the F2 layer of the Ionosphere was estimated before recent large earthquakes using high frequency GPS observations. In this particular approach, data from continuously operating at 1 Hz GPS stations located in the vicinity and far away from the earthquake epicenter were employed to calculate vertical TEC values. The median rate, as obtained by averaging TEC values of the pre-earthquake period, was used as a reference level to monitor ionospheric TEC variations. It was found that significant deviations of the current TEC values from median ones were observed at nearby stations within a few days prior to the latest earthquakes. Indicatively, the present research revealed anomalous ionospheric variation two days before the Mw=6.4 Andravida Earthquake (June 8, 2008) at the NW part of Peloponnese. Considering the prevailing quiet geomagnetic conditions, vertical TEC values ranging between 5.0 and 6.4 TECU were observed above the available CGPS stations, which correspond to 25-42% ionospheric increase relative to non-disturbed conditions, while the disturbed ionospheric area exceeded 400 km. Another anomalous TEC increase was detected at the nearest to the epicenter CGPS stations few hours after the main event had occurred, reaching 6.6 TECU. This specific anomaly accounts for 65% increase from the normal ionospheric level and may be attributed to the main aftershock event (Mw=5). Applying the Dobrovolsky et al. (1979) equation for the Mw=6.4 main event, the size of the earthquake preparation zone at the Lithosphere was found to be of the same order of magnitude as the ionospheric area of the anomalous TEC variations that is consistent by Ruzhin et al. (1996). It is therefore concluded that the observed ionospheric anomalies may constitute precursors associated with the Andravida Earthquake.